

Nebraska Wind & the SPP Integrated Marketplace

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Omaha, NE

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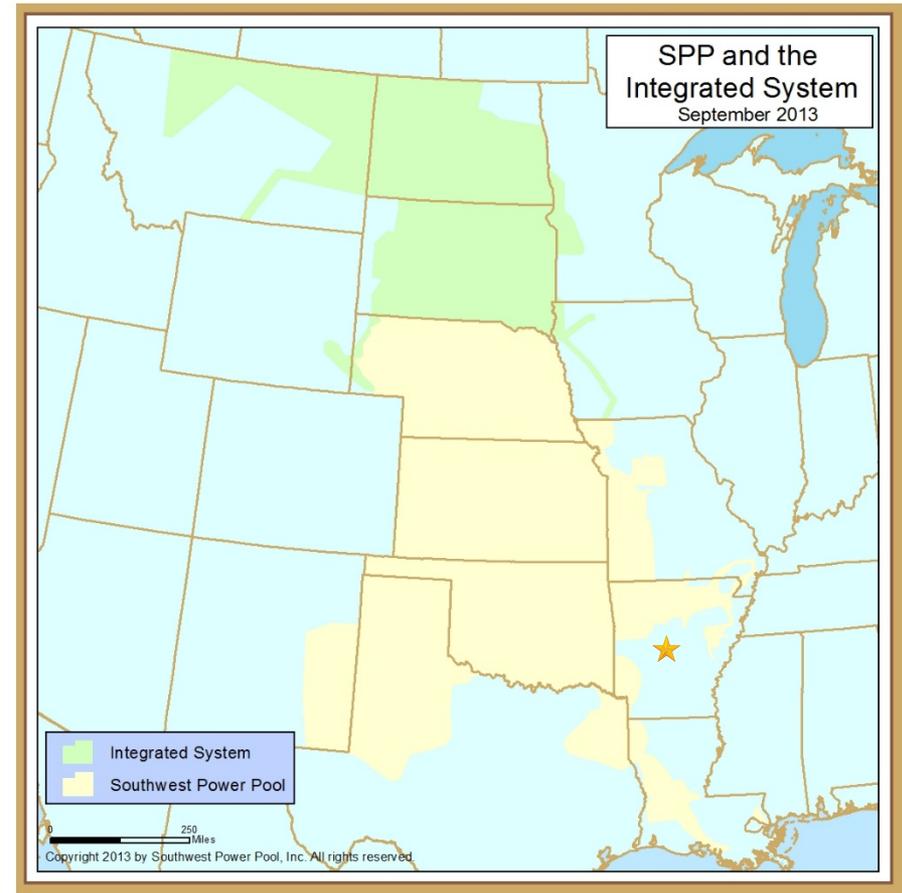


Agenda

- **SPP Overview**
- **Integrated Marketplace Overview**
- **Integrated Marketplace Observations**
- **Variable Energy Resources in SPP**

Southwest Power Pool

- Independent, non-profit, Regional Transmission Organization
- Membership in 8 states
 - Arkansas, Kansas, Louisiana, Missouri, Nebraska, New Mexico, Oklahoma, and Texas
- Future Membership from the 'IS Integration' primarily includes North Dakota and South Dakota (October 2015)
- SPP Headquarters in Little Rock, Arkansas
 - ~570 employees
 - 24 x 7 operations
 - Reliability Coordination
 - Market Operations
 - Transmission Planning
 - Tariff Administration
 - Regional Scheduling



What is Integrated Marketplace?

- **New “Day-2” Market implemented March 1, 2014**
 - **Replaced Energy Imbalance Service (EIS) Market launched in 2007**
- **SPP consolidated all EIS member Balancing Authorities (BA) into one SPP BA**
- **Day-Ahead Market, Reliability Unit Commitment, Real-Time Balancing, and Transmission Congestion Rights (TCR) Market**
 - **Products: Energy, Regulation-Up, Regulation-Down, Spinning, Supplemental**
 - **Security Constrained Unit Commitment (SCUC), Security Constrained Economic Dispatch (SCED), Co-Optimization**

Integrated Marketplace Observations

- **122 Market Participants (MPs)**
 - Asset owning and financial only entities
 - 8 MPs in Nebraska
- **Go-live weekend challenges**
 - Extreme cold weather in the footprint and US
 - First time SPP and members performed the beginning-to-end centralized unit commitment process

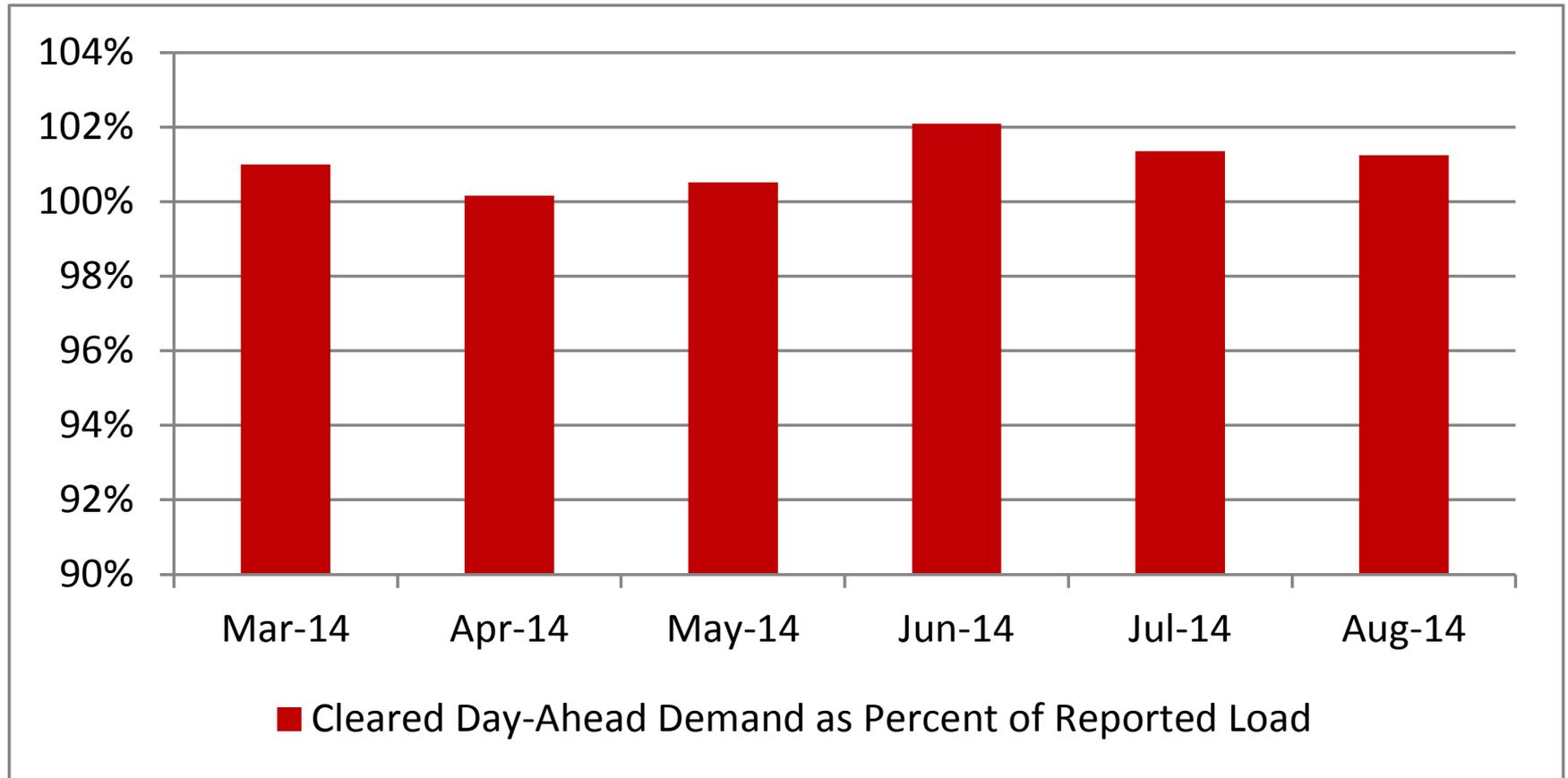
Integrated Marketplace Observations

- **Learning process for both SPP and MPs on Reliability Unit Commitment (RUC)**
 - **Unit commitment patterns have changed**
 - SPP is using more “quick start capable” resources than anticipated
 - More local commitments than anticipated
- **System availability has exceeded expectations**
 - **Day-Ahead Market has posted on-time every day except once in early June (due to a modeling issue)**
 - **Real-Time Balancing Market has successfully solved 99.98% of all intervals**
 - **Considerably higher than during Market Trials**

Integrated Marketplace Observations

- In general, the Marketplace is working as expected
- Any surprises or unexpected behavior?
 - DAMKT load participation
 - DAMKT vs RTBM LMPs
 - TCR Funding

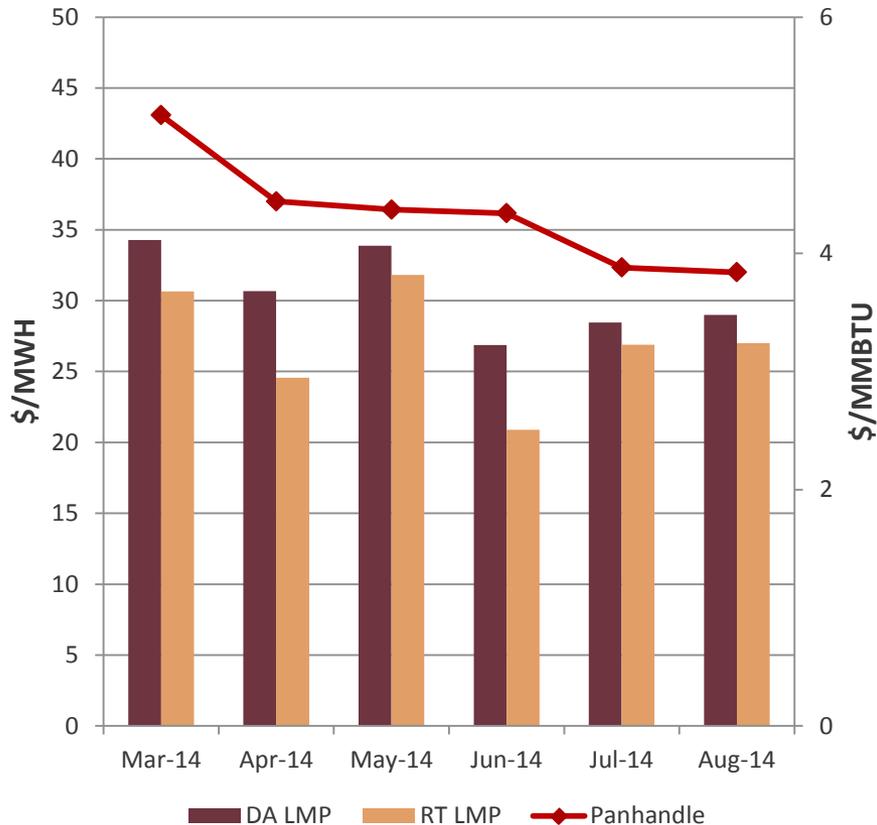
Load Participation in the DA Market



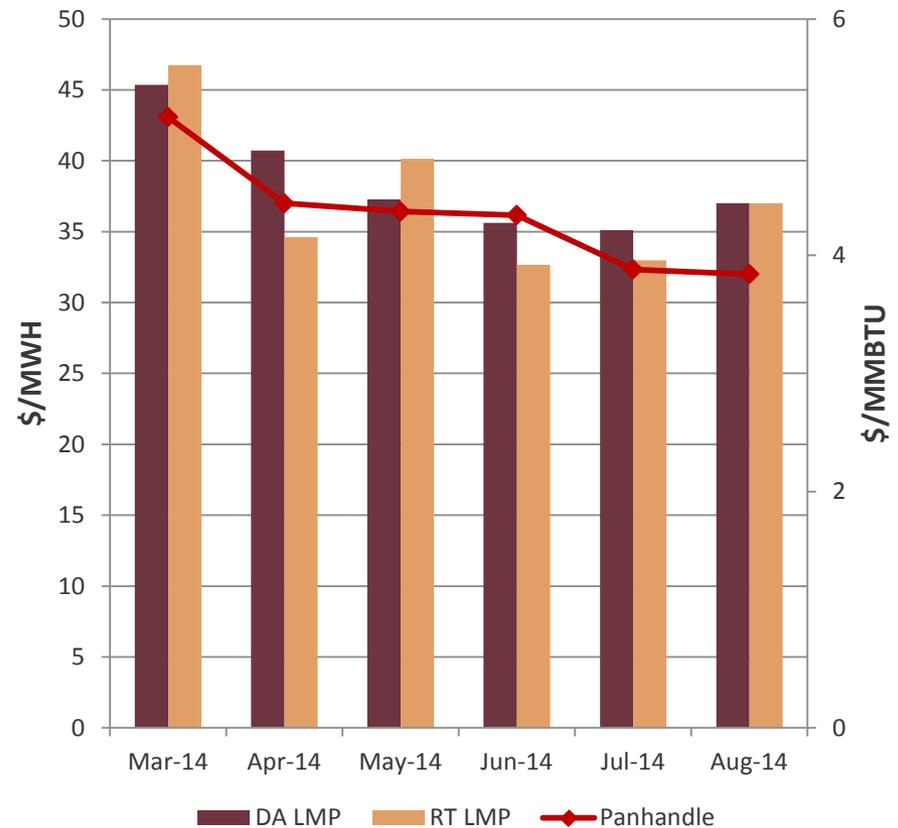
** The metered load number used in this chart does not include losses

Monthly Average LMPs

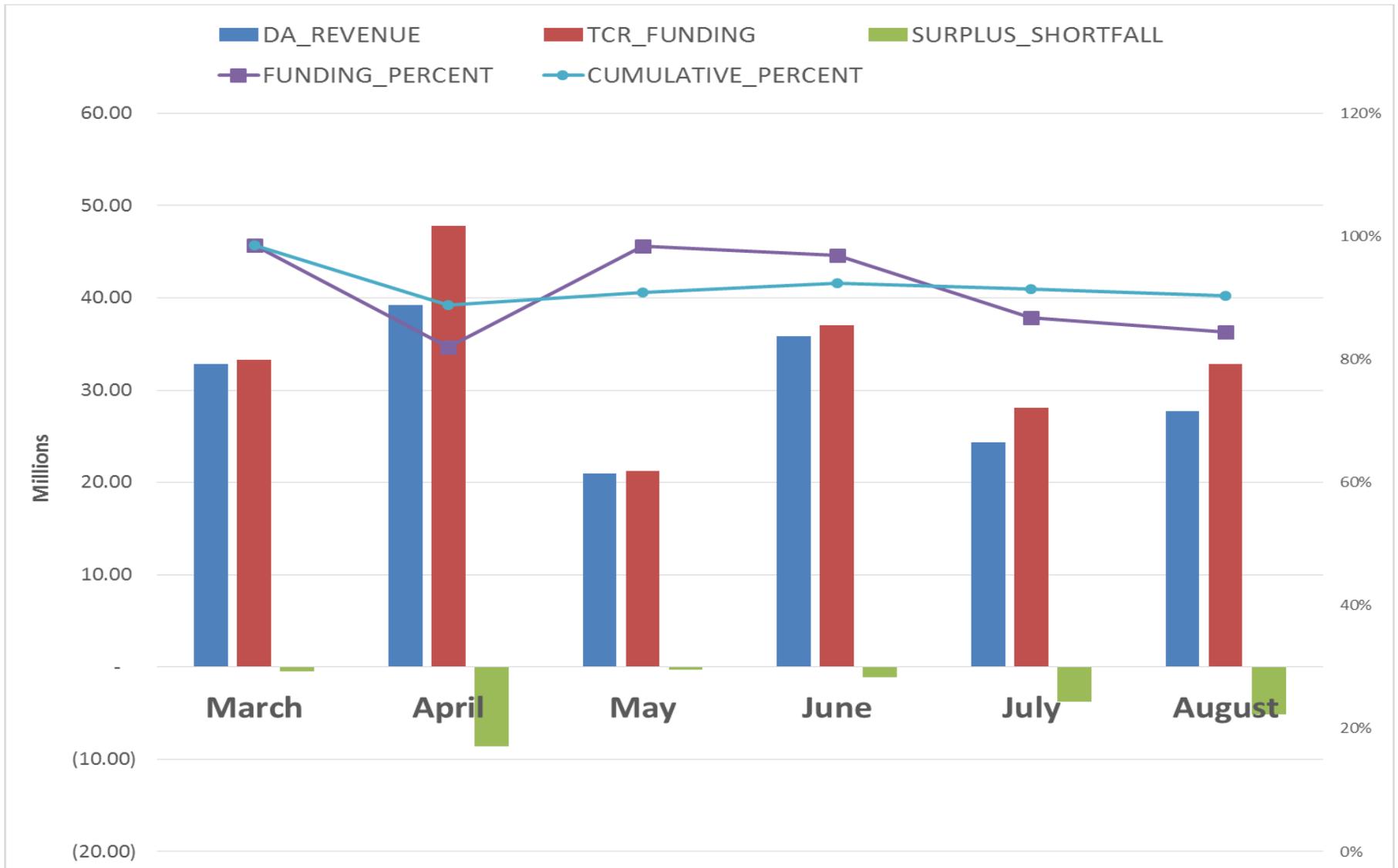
SPP NORTH HUB



SPP SOUTH HUB



TCR Summary by Month



VERs in the Integrated Marketplace

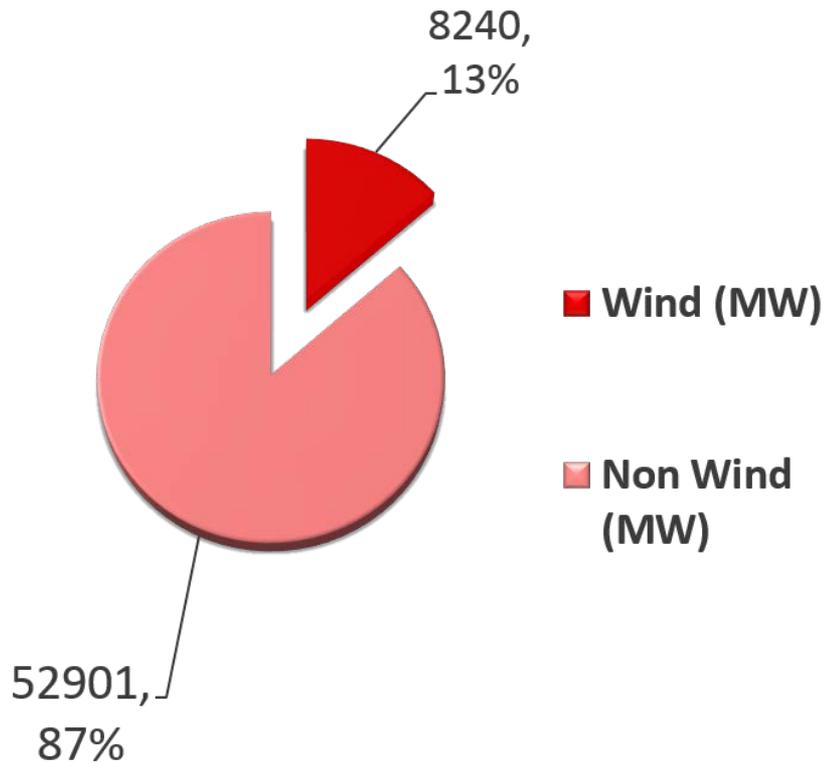
- Wind may participate in the Integrated Marketplace via the VER registration
 - Variable Energy Resource (VER)
 - A Resource powered solely by wind, solar energy, run-of-river hydro or other unpredictable fuel source that is beyond the control of the resource operator.
 - Dispatchable Variable Energy Resource (DVER):
 - » A Variable Energy Resource that is capable of being incrementally dispatched down by SPP
 - Non-Dispatchable Variable Energy Resource (NDVER):
 - » A Variable Energy Resource that is not capable of being incrementally dispatched down by SPP

VERs in the Integrated Marketplace

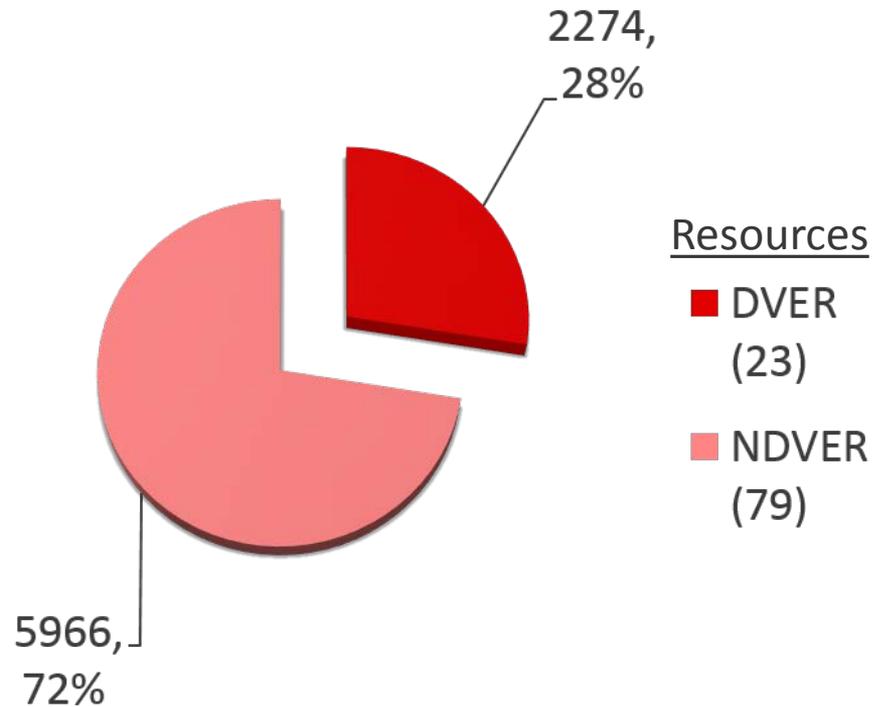
- All VERs must register as a Dispatchable VER (DVER) except for VERs with an interconnection agreement executed prior to May 21, 2011 and commercially operational by October 15, 2012.
 - If not a DVER, the resource must register as a Non-Dispatchable VER (NDVER)
- Registered Nebraska Wind
 - NDVERs (9)
 - DVERs (1)

Wind in SPP's Footprint

Registered Gen in SPP (MW)



Wind Registration (MW)



Wind In Service

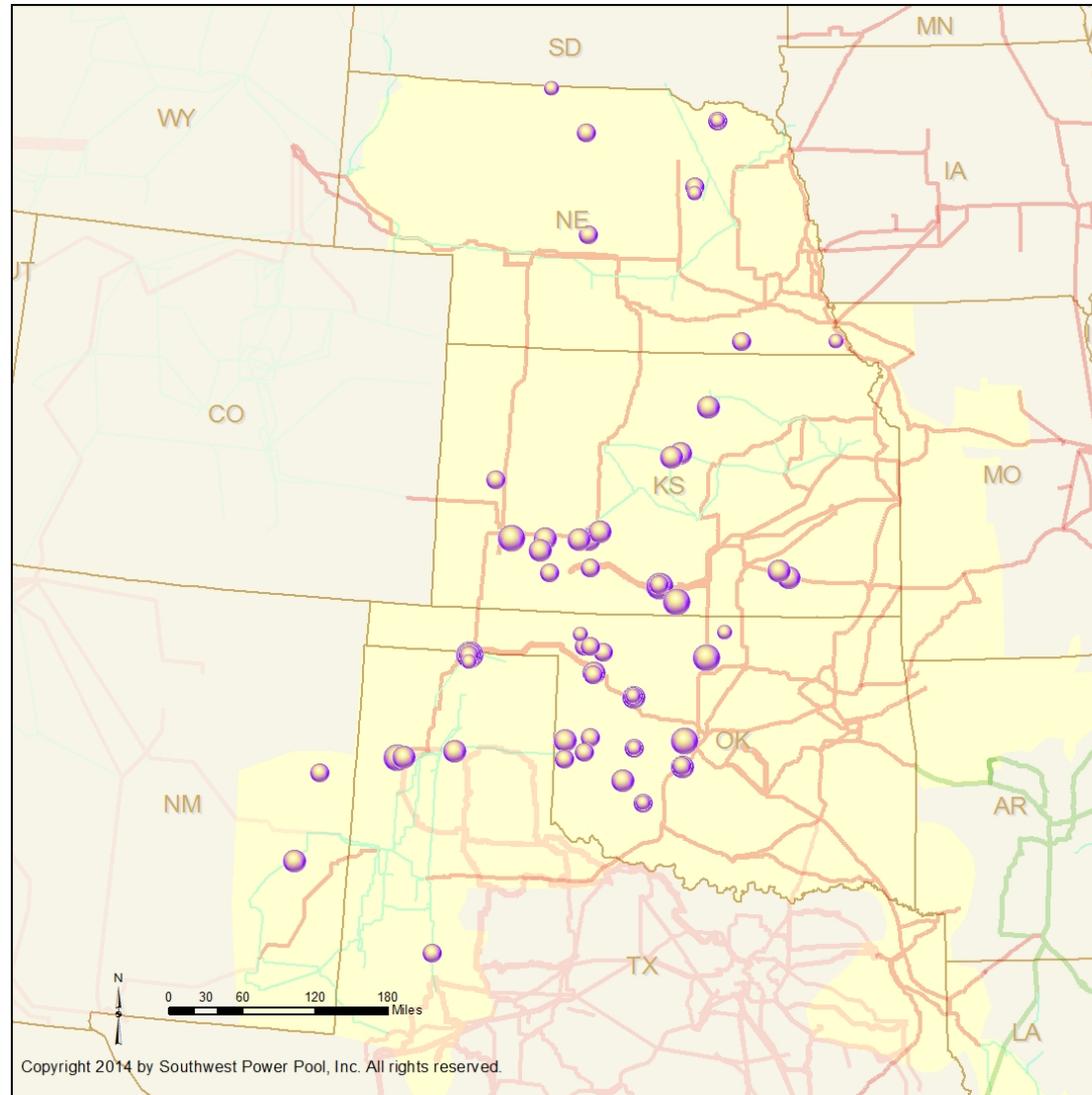


Wind Generation In Service (October 2014)

All SPP Transmission Expansion
Plans are subject to change.

Size of GI Request (MW)

- 1 - 60
- 61 - 140
- 141 - 250
- 251 - 550
- 551 - 1000



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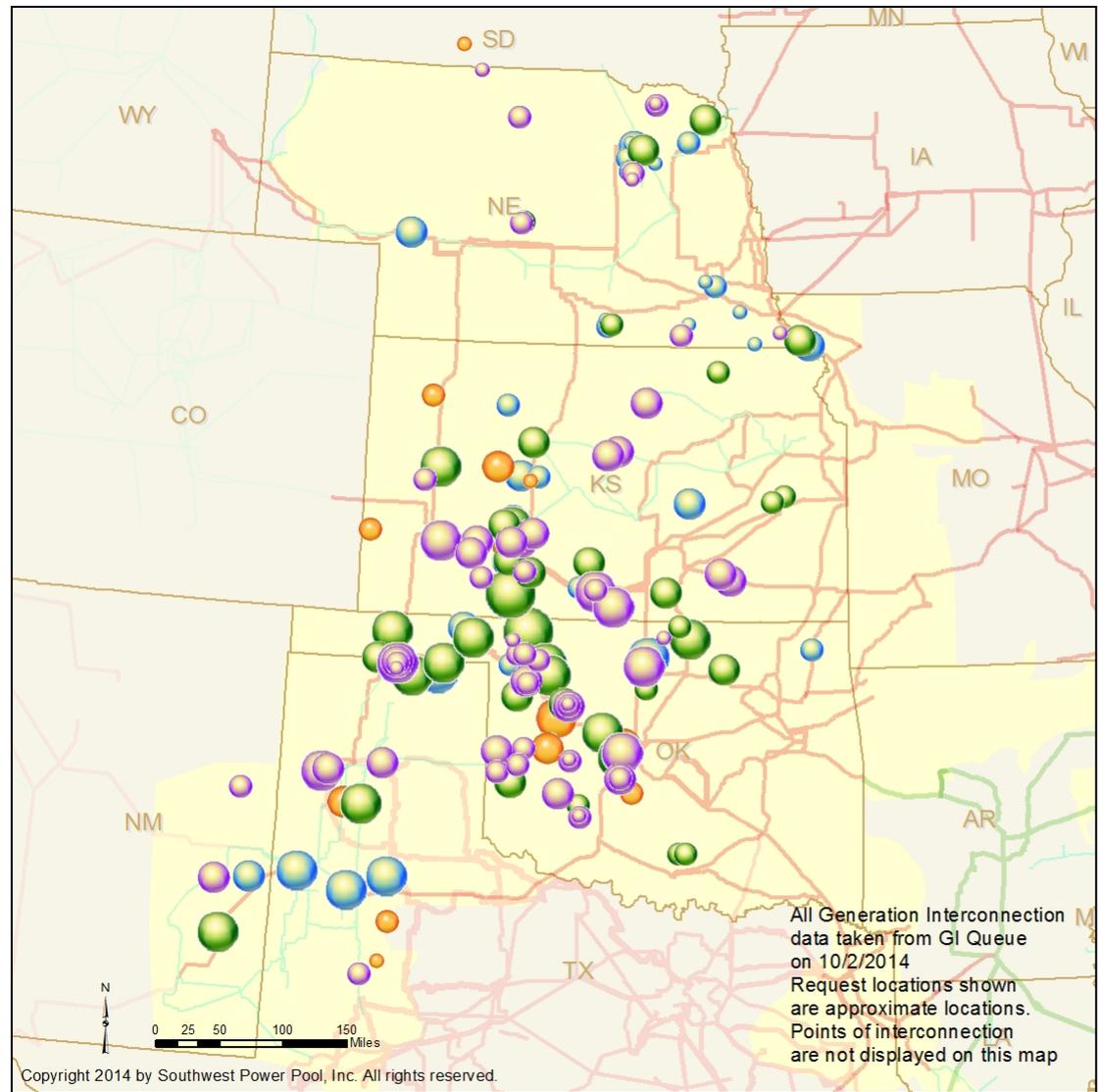
Generation Interconnection Requests



GI Requests (Wind)
(As of October 2014)

- Status of GI Request**
- Signed IA/In Service
 - Signed IA/On Schedule
 - Signed IA/On Suspension
 - Under Study

- Size of GI Request (MW)**
- 1 - 60
 - 61 - 140
 - 141 - 250
 - 251 - 550
 - 551 - 1000

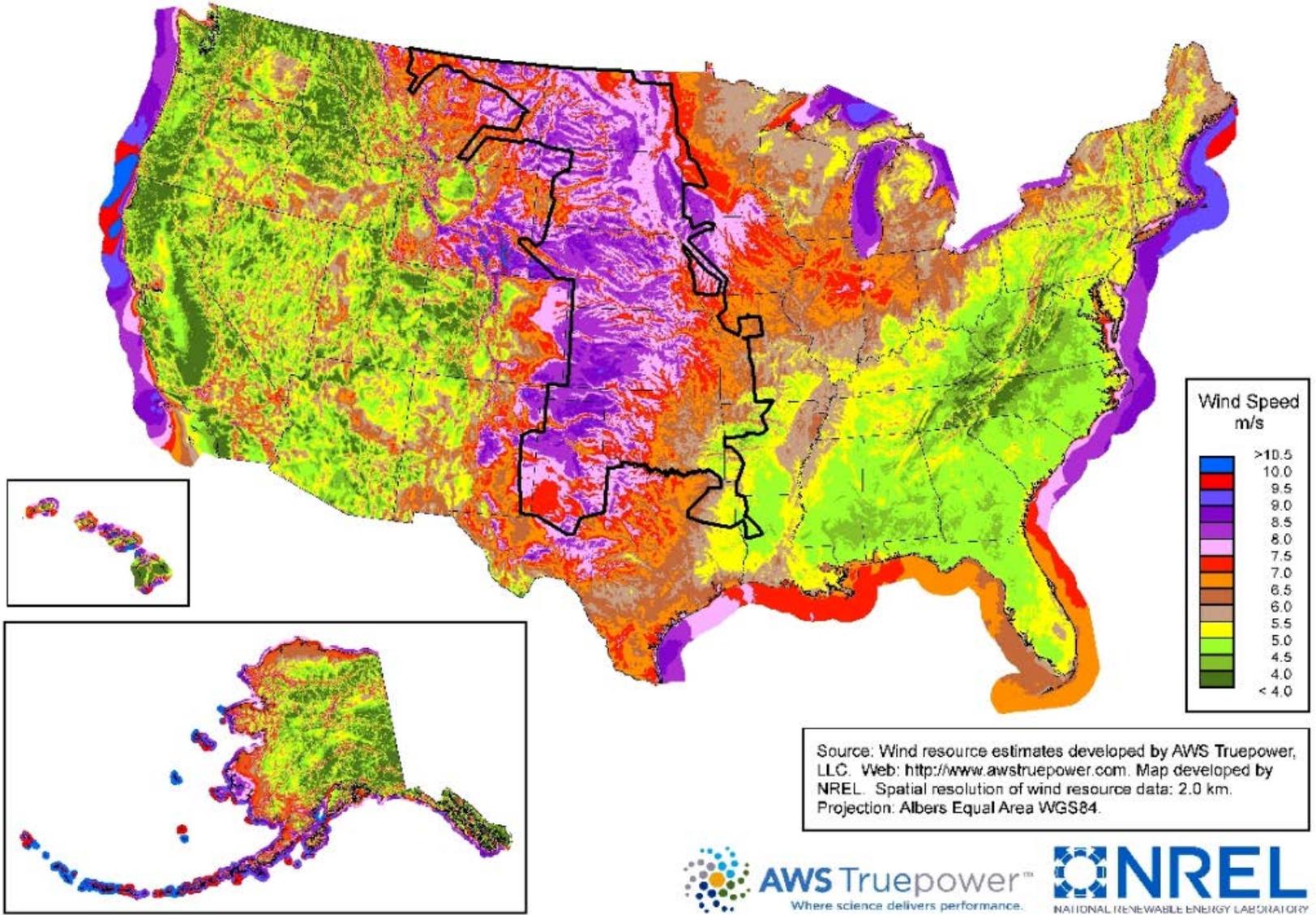


All Generation Interconnection data taken from GI Queue on 10/2/2014
Request locations shown are approximate locations.
Points of interconnection are not displayed on this map

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Wind Speeds in SPP

United States - Land-Based and Offshore Annual Average Wind Speed at 80 m



AWS Truepower[™]
Where science delivers performance.



NREL
NATIONAL RENEWABLE ENERGY LABORATORY



VERs in the Day-Ahead Market

- **In Day-Ahead Market, VERs may participate as a traditional resource**
 - **VERs will submit offer curves, resource min and max parameters, and ramp rate information and be able to set price**
 - **May provide regulation-down, if qualified but not regulation-up/spinning/supplemental products**



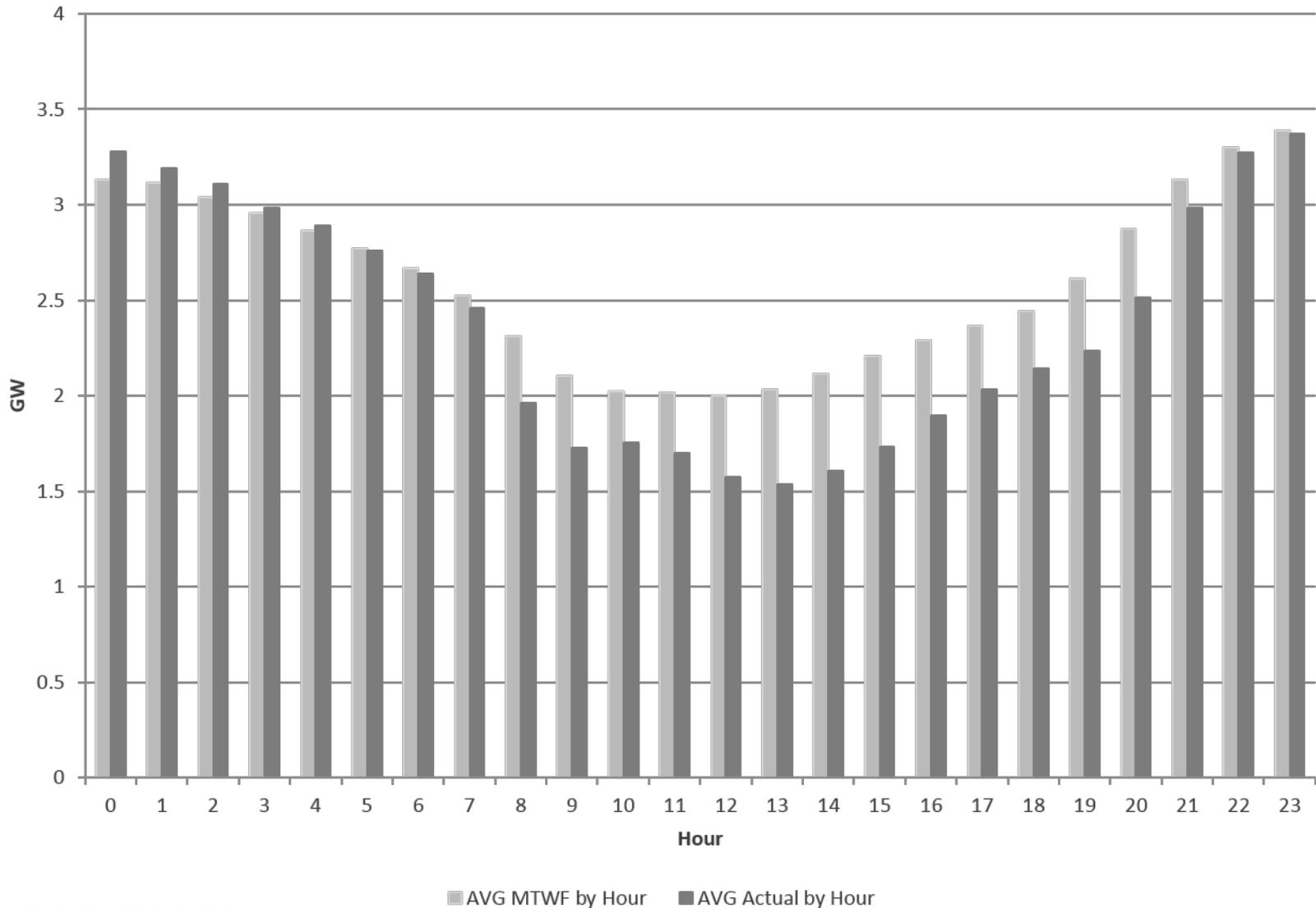
VERs in the Real-Time Balancing Market

- **DVER dispatch in Real-Time**
 - Persistence (the setpoint equals actual output) is used when the locational marginal price (LMP) is greater than the submitted offer price.
 - When the LMP is less than the submitted offer price, the resource is incrementally dispatched down using the submitted ramp rate.
- **NDVER dispatch in Real-Time**
 - Persistence is used at all times unless SPP Reliability Coordination is required to manually dispatch the resource (Out of Merit Energy) to resolve or prevent an Emergency Condition

VERs in the Real-Time Balancing Market

- **Reliability Unit Commitment (RUC) processes prior to the RTBM**
 - **Day-Ahead RUC**
 - Runs shortly after DAMKT
 - **Intra-Day RUC**
 - Runs at least every 4 hours
 - **Uses forecasted load**
 - **Uses wind forecast**
 - **Allows for additional commitments closer to real-time**

MTWF by Hour of the Day for August



Integrated Marketplace Next Steps for VERs

- **SPP is a Member driven Organization**
- **SPP Members and Stakeholders are continually looking at ways to improve the Market**
 - **SPP uses the Market Working Group to facilitate new design proposals**
 - **Monthly face-to-face meetings in Dallas**
 - **Open meetings**
 - **Register for meetings on SPP.ORG**
 - **Sign up for email exploders on SPP.ORG**





Helping our members work together to keep the lights on...
today and in the future

